

## REMARKS

In the Office Action mailed November 18, 2004, the Examiner noted that claims 5 and 11-23 were pending, allowed claim 5, and rejected claims 11-23. Claims 5 and 11-23 remain pending for reconsideration which is requested. No new matter has been added. The Examiner's rejections are traversed below.

Page 6 of the Office Action rejects claims 11-23 under 35 U.S.C. § 103 over Lynch and Yagasaki.

The present invention is concerned with efficient entropy encoding of data representing motion vectors.

### Background

With respect to Shannon's information theory, when performing entropy encoding on information, the entropy associated with symbols is reduced if the symbols are divided into a number of groups and the thus grouped symbols are encoded respectively under specific conditions. The amount of the achieved reduction in entropy is correspondent to mutual information, common or corresponding.

In particular, if we define for a given signal  $X$  and a given condition  $Y$ :

$H(X)$ : entropy of original information (unconditional entropy)

$H(X|Y)$ : entropy under the condition  $Y$  (conditional *entropy*)

$I(X;Y)$ : mutual information amount between  $X$  and  $Y$ . then, there holds, among these parameters, a relation:  $H(X|Y) = H(X) - I(X;Y)$

Details in this area of technology may be found, for example, at Internet page addresses:

[http://en.wikipedia.org/wiki/Information\\_theory](http://en.wikipedia.org/wiki/Information_theory) and

[http://en.wikipedia.org/wiki/Mutual\\_information](http://en.wikipedia.org/wiki/Mutual_information).

In addition to these sites, an introduction to the Shannon's encoding theory can be found in a number of textbooks published on the related technology areas. In the site,

[http://en.wikipedia.org/wiki/Information\\_theory](http://en.wikipedia.org/wiki/Information_theory),

we find a description, which reads:

" $H(X|Y)$  is the conditional entropy of  $X$  conditioned on observing  $Y$ ." And further, reads:

"As such, the mutual information can be intuitively considered the amount of uncertainty in  $X$  that is eliminated by observations of  $Y$ ."

From this description, we can understand that the following formula,

$$H(X|Y) = H(X) - I(X;Y)$$

implies that the amount or number of codes (=entropy) resulting from the unconditioned encoding of  $X$  is reduced if  $X$  is encoded by observing event  $Y$ , of which the reduction amount is correspondent to mutual information amount  $I(X;Y)$ . What is meant here, in this case, is that the amount of the information that needs to be encoded reduces because  $H(X|Y) \leq H(X)$ .

The present invention is concerned with reducing an amount of codes representing motion vectors and exploiting the Shannon's information theory for accomplishing this objective. In particular, the present invention is concerned with reducing uncertainty associated with event  $X$ , i.e., a motion vector by observing event  $Y$ , i.e., the randomness of nearby motion vectors (the reduction amount equals the amount of mutual information between event  $X$  and event  $Y$ ), in a course of representing event  $X$ , the motion vector, by an encoded form of data so that the amount of the encoded form data becomes less than that produced without observing event  $Y$ .

When actually encoding a given vector, we first obtain a prediction vector based on vectors located near the given vector and then calculate a difference between the given vector and the obtained prediction vector. This difference corresponds to the event  $X$  noted in the above explanation.

In the present invention,  $X$  (the difference between the above two vectors) with observation of the event  $Y$  (the randomness of nearby vectors) can be encoded with smaller amounts of information than  $X$  without the event  $Y$ . The most important aspect of the present invention lies in the fact that the inventors found the amount of common or mutual information  $I(X;Y)$  defined between the vector difference associated with event  $X$  and event  $Y$ , the randomness of nearby vectors, was large and succeeded in reducing data amount of encoded data using this finding.

The invention, in practice, classifies vector differences  $X$  into a number of groups according to the levels of randomness of nearby vectors  $Y$ . The higher the randomness level of the nearby vectors, the wider the distribution range to which the vector differences  $X$  belong. Conversely, the lower the randomness level, the closer to zero the vector difference  $X$ . Let's assume a case in which vector differences  $X$  are classified into two groups,  $X_{\text{High}}$  and  $X_{\text{Low}}$ , representing respectively a group of vector differences of which the associated nearby vector

randomness levels are high and a group of vector differences of which the associated nearby vector randomness levels are low. Then, the vector differences of the  $X_{\text{High}}$  group form a probability density function (PDF) that indicates occurrences of large vector difference values reflecting the higher level of nearby vector randomness. The vector variances of the  $X_{\text{Low}}$  group, in contrast, form a PDF that peaks at zero reflecting the low level of nearby vector randomness. Shannon teaches that the optimum entropy encoding is achieved, in general, by adjusting the encoding method depending on the PDF associated with the subject set. This teaching supports the concept behind the present invention, for example, in the above-introduced case, it is possible to reduce the information amount in a manner in which the encoding vector differences of  $X_{\text{High}}$  and  $X_{\text{Low}}$  groups separately under entropy encoding rules optimized for these groups respectively.

### The References

The Examiner states: "**Lynch** discloses ... predicting a motion vector of a target block based on motion vectors of a plurality of blocks adjacent to the target block, as disclosed in fig.17 and col. 10, line 23, to col. 11, line 4, ...". We argue that this is not the case. The **Lynch** text from col. 10, line 23 to col. 11, line 4 contains the word, "prediction", which we find to imply "prediction of an image" or "prediction of pixels" but does not imply "prediction of a motion vector". The document of **Lynch** does not contain the phrase, "prediction of a motion vector", at all or anything like that.

In the document of **Lynch**, "prediction" only implies predicting images  $B_1$  and  $B_2$ , namely, predicting pixels as evidenced by the text from col. 10, line 28 to col. 10, line 30, which reads, "reference is made to the use of motion vectors for frame  $P_3$  (with respect to  $I_0$ ) for the purpose of predicting  $B_1$  and  $B_2$ ".

The Examiner, further, says of **Lynch**, "Fig.14 shows that the target block motion vector was predicted for accurately predicting the image data, especially in the MPEG interframe encoding/decoding environment". We disagree with this interpretation by the Examiner. The motion vector in Fig.14 only indicates that a vector itself is used for predicting an image and, therefore, the Fig.14 chart does not anywhere contain a block concerned with predicting a vector.

It is normally the case that a VLC unit is involved in encoding a given vector using predicted vector values. A VLC block indicated by numeral 13 shown in the Fig. 14 is involved with a predictive encoding process of the given vector.

With respect to Fig.5, the Examiner alleges that the shaded block is used for predicting a vector. We find, contrary to the Examiner's interpretation, that "the shaded part is predicted by using a vector" and that this would be obvious to a person in the art of the moving image encoding technology.

The Examiner points to col.18, lines 1-13 of **Yagasaki** and says the method of obtaining a predicted motion vector (prediction vector) associated with the present application is a prior art technology. The inventor agrees with the Examiner on this narrow point. It is within the prior art to obtain a prediction vector from nearby blocks.

**Yagasaki's** document, however, uses the word, "accuracy", appearing in col. 22, lines 3-10, in a different sense from the same word used in the present application. The word, "accuracy", in **Yagasaki** implies "resolution of the vector per an unit" which becomes clear from claim 4 of **Yagasaki**, which reads, "... degree of accuracy with respect to which said input motion vector was formed is 0.5 picture element ...". One unit defined in the document of **Yagasaki** for a vector, namely the "degree of accuracy" defined there is 0.5 pixels of an image. This implies that the word, "accuracy", means "resolution of a motion vector per unit". According to the present application, "accuracy" is used as a measure of closeness of a prediction vector to a given vector (a vector to be encoded), or in other words, is used as an indicator indicating how small is the difference between the two vectors.

The Examiner says further with respect to **Lynch** that: "col. 11, lines 18-22 and fig.17, note "MODE" is determined and motion vector calculator 111 determines the prediction accuracy based on non-uniformity of the plural motion vectors". We contend that the document of **Lynch** does not support the Examiner's interpretation. **Lynch** does not contain any discussion related to the concept, "non-uniformity", at all. This text in the **Lynch** is concerned with the method of generating a predicted image, which has nothing to do with a prediction of a vector. "Prediction Mode" appearing in this text of **Lynch** is also concerned with prediction of an image, and has nothing to do with producing a prediction vector of a given vector. This Prediction Mode understanding would be obvious to a person in the art, particularly to a person in the art of the MPEG-2 related area.

The Examiner, yet further says col. 3, lines 54-61 in the **Yagasaki** document is concerned with "accuracy of a vector". "Accuracy" in this text, which becomes clear from claim 4 in the **Yagasaki** document, implies resolution (or definition) of a motion vector. This implication of "accuracy" is completely different from the implication of "accuracy" assumed in the present

application, i.e., the certainty of prediction associated with a prediction vector predicted for a given motion vector.

It is submitted that it is not possible to deduce or anticipate or imply the present invention from any combination of technologies associated with the *Lynch* and *Yagasaki* discussions.

#### The Claims

The Examiner indicates that it is obvious to predict and encode a vector based only on the fact that the word, "prediction", appears in Fig.17 of *Lynch*. The word, "prediction", used in *Lynch* is not in relation to prediction of a vector, but used for a prediction of an image block in association with a hybrid encoding technology. The distinction of this nature is only a basic part of the technology well understood by a person in the art and the Examiner is misinterpreting the reference here. We agree with the Examiner to a limited extent that *Yagasaki* is concerned with encoding a given motion vector using a prediction vector. But we must point out that the *Yagasaki* document does not describe anything in relation to the correctness (closeness) of vectors in an area adjacent to a given vector to the given vector or anything about evaluating how well a prediction vector predicts a motion vector. It has been pointed out previously that "accuracy" in the *Yagasaki* document means definition or resolution of a vector and is entirely different from the meaning for which same word is used in the present application.

Based on this, we contend that it is impossible to arrive at the present invention by any combination of the technologies associated with the *Yagasaki* and *Lynch* inventions.

These arguments apply equally to claims 12-13, 20-22 and 14-16.

With respect to claims 17-19, we submit as follows. The Examiner says that *Lynch* describes an encoding process that involves a plurality of motion compensation units and therefore these claims stand rejected. We do not accept this view of the Examiner. As previously explained, what *Lynch* describes is a technology called "motion compensation" and is concerned with predicting an image block using motion vectors. The present invention, on the other hand, is concerned with progressing with encoding of a motion vector using a prediction vector. What the process in *Lynch* predicts is an image block, which is, at least would be very obvious to a person in the art, different from a vector that a process of the present invention predicts.

With respect to claim 23, we submit that the Examiner appears to be confused with the implication of the modes shown in the Fig.17 diagram. Contrary to the Examiner's understanding, BMv, FMv and AO are not concerned with calculation of any motion vector. The

**Lynch** document does not contain text that means anything of a sort that the Examiner interprets. What are meant by abbreviations such as BMv, FMv and so on are motion vectors each being used for predicting an image block (not for predicting a vector) in a manner called a backward prediction, a forward prediction or a both-direction prediction in association with a process of a hybrid motion image encoding technology, such as MPEG-2.

It is submitted that, for the above-discussed reasons, the invention of claims 11-23 distinguishes over the prior art and withdrawal of the rejection is requested.

If any further fees, other than and except for the issue fee, are necessary with respect to this paper, the U.S.P.T.O. is requested to obtain the same from deposit account number 19-3935.

Respectfully submitted,

STAAS & HALSEY LLP

Date: \_\_\_\_\_

5/16/15

By: \_\_\_\_\_



Randall Beckers  
Registration No. 30,358

1201 New York Ave, N.W., Suite 700  
Washington, D.C. 20005  
Telephone: (202) 434-1500  
Facsimile: (202) 434-1501